

## REMARKS

Claims 1 – 17 are pending.

### I. Claim Objection

The Office action objects to Claim 1 for reciting “aluminium”. Applicant submits there is no need to amend Claim 1 to change this spelling. This spelling is the British English spelling for this element as indicated by the attached *Grant & Hackh's Chemical Dictionary* definition (ATTACHMENT I). MPEP 608.01 states:

Examiners should not object to the specification and/or claims in patent applications merely because applicants are using British English spellings (e.g., colour) rather than American English spellings. It is not necessary to replace the British English spellings with the equivalent American English spellings in the U.S. patent applications. Note that 37 CFR 1.52(b)(1)(ii) only requires the application to be in the English language. There is no additional requirement that the English must be American English.

### II. 35 U.S.C. §112, first paragraph

The Office action rejects claims 15 – 17, citing 35 U.S.C. §112, first paragraph.

Claim 15 recites "wherein the concentration of the  $\text{Al}_2\text{S}_3$  is in the range 4 to 10 wt%." Page 12, lines 14 – 15 indicate the amount of  $\text{Al}_2\text{S}_3$  added to the quaternary mixture was increased from 4% to 10% and cites Fig. 3, Examples C and D. Fig. 3 shows Example C at 4% and Example D at 10 %. Thus, the specification and Fig. 3 supports a concentration of  $\text{Al}_2\text{S}_3$  ranging from 4% to 10%. The single values make a range. Furthermore, page 4, lines 1 – 2 describes the addition of 5 – 10 wt %  $\text{Al}_2\text{S}_3$ . Thus, the 4% value merely extends the 5 to 10% range.

This also follows from the case of *In re Wertheim* cited in MPEP 2163.05.III. In the decision in *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976), the ranges described in the original specification included a range of "25%- 60%" and specific examples of "36%" and "50%." A corresponding new claim limitation to "at least 35%" did not meet the description requirement because the phrase "at least" had no upper limit and caused the claim to read literally on embodiments outside the "25% to 60%" range, however a limitation to "between 35% and 60%" did meet the description requirement.

The issue is whether the written description is sufficient to indicate the applicant possessed the invention. The application disclosed (A) electrolyzing  $\text{Al}_2\text{S}_3$  in a bath of molten chloride salt in which the  $\text{Al}_2\text{S}_3$  is dissolved without limiting the amount of  $\text{Al}_2\text{S}_3$ , (B) 4% and 10%  $\text{Al}_2\text{S}_3$  examples, and (C) a range of 5 to 10%  $\text{Al}_2\text{S}_3$ . From this it is apparent the inventors contemplated 4.1%  $\text{Al}_2\text{S}_3$  and any other amount between 4 and 5%. Thus, there is support for the entire 4-10% range.

III. 35 U.S.C. §103(a)

A. Claims 1 – 5, 7 – 9, and 11 – 17

The Office action rejects claims 1 – 5, 7 – 9, and 11 – 17, citing 35 U.S.C. §103(a), US 4,464,234 to Minh et al. (hereinafter, “Minh”), and Khazanov et al. “Electrolysis of Fused Aluminum Sulfide,” Legkie Metally (1935), Vol. 4, No. 11, pp. 1 - 14 (hereinafter, “Khazanov”).

Minh teaches a process for the production of primary aluminum, comprising: electrolyzing (conducting electrolysis of the bath) [col. 3, ll. 55 - 60] of  $\text{Al}_2\text{S}_3$  in a bath of molten chloride salt in which the  $\text{Al}_2\text{S}_3$  is dissolved (the molten bath is prepared from aluminum sulfide, the alkali metal chloride or chlorides, and the chloride component composed of one or more alkaline earth metal chlorides, ammonium chloride, or mixtures of these chlorides) [col. 3, ll. 44 - 49], wherein the molten chloride salt comprises a  $\text{MgCl}_2$ - $\text{NaCl}$ - $\text{KCl}$  mixture (cols. 4-6, Examples I-III).

The Office action appreciates the process of Minh differs from the instant invention because Minh does not disclose that an additive comprising a fluoride compound is added to the bath to improve the electrical conductivity of the bath to enable an increase in the current density in the bath, as recited in claim 1.

However, the Office action argues that like Minh, Khazanov teaches the electrolysis of  $\text{Al}_2\text{S}_3$  in a molten bath of  $\text{NaCl}$ - $\text{KCl}$ - $3\text{NaF}\cdot\text{AlF}_3$  (p. 13, Table 17). Also, the Office action argues Khazanov teaches increasing the concentration of cryolite ( $3\text{NaF}\cdot\text{AlF}_3$ ) increases the current yield (p. 5, ll. 15 - 31; Table 6, and Figs. 1 - 2). Thus, the Office action concludes it would have been obvious to one skilled in the art to have modified the bath described by Minh with a fluoride compound or cryolite, because adding cryolite to the bath would have increased the current yield.

This rejection is respectfully traversed.

Minh et al. has been cited as being the closest prior art to the present application (see p. 2, l. 11 et seq.). From Minh et al. it is known to use a bath of molten chloride salts comprising NaCl, KCl and  $Mg_2Cl_2$ . In particular,  $Mg_2Cl_2$  is added to increase the solubility of  $Al_2S_3$  since the solubility in a bath of molten NaCl and KCl is negligible.

However, the present inventors realized addition of suitable additives like cryolite increases the solubility of  $Al_2S_3$  in the bath of molten alkali metal chlorides to a level at which the solubility is no longer the limiting factor in the electrolysis process but the conductivity. This has opened the way to simple and more environmentally friendly bath (see p. 7, ll. 25 – 32 of the present application).

The proposed combination of Minh and Khazanov is based on a hindsight reconstruction of the present invention. At the time the present invention was made, the combination of Minh and Khazanov would not have prompted a person having ordinary skill in the art to arrive at the present invention.

Furthermore, even a person having ordinary skill in the art combining the teachings of Minh and Khazanov will not arrive at the subject-matter of the present claims.

Khazanov tests salt mixtures. Table 17 on page 13 of Khazanov discloses the current output for salt mixtures, but a steady cryolite content of 30 wt. % is employed. Table 17 indicates a mixture of NaCl and KCl (28 wt. % and 42 wt. %) has a better current output than KCl alone. Since the cryolite content is the same, a skilled artisan would have attributed the better current output to the chemical composition of the salt mixture. Khazanov provides no apparent reason for one of ordinary skill in the art to assume improved current output could be achieved by the addition of cryolite to a bath of molten chloride salt comprising a  $MgCl_2$ -NaCl-KCl mixture.

Moreover, Table 6 of Khazanov indicates the current output in a NaCl- $AlF_3$ -3NaF alloy is better if the cryolite content is high. However, a person having ordinary skill in the art had no reason to assume this result, achieved for NaCl only, would be achieved with a salt mixture containing NaCl and KCl, or a salt mixture containing NaCl, KCl, and  $MgCl_2$ .

Thus, the subject matter of present claim 1 distinguishes over a combination of

the teaching of Khazanov and Minh.

Claims 11, 12 and 15-17 further distinguish over the references by selecting specific levels of  $\text{Al}_2\text{S}_3$  and cryolite.

B. Claim 6

The Office action rejects claim 6, citing 35 U.S.C. §103(a), Minh, Khazanov, and US 2,939,824 to Greenfield (hereinafter, “Greenfield”). The discussion above regarding the combination of Minh and Khazanov applies to claim 6, because claim 6 depends from claim 1. Greenfield is not cited to compensate for the shortcomings of the combination of Minh and Khazanov.

C. Claim 10

The Office action rejects claim 10, citing 35 U.S.C. §103(a), Minh, Khazanov, and US 4,133,727 to Rogers, Jr. (hereinafter, “Rogers”). The discussion above regarding the combination of Minh and Khazanov applies to claim 10, because claim 10 depends from claim 1. Rogers is not cited to compensate for the shortcomings of the combination of Minh and Khazanov.

IV. Conclusion

Please charge any shortage in fees due in connection with the filing of this paper, including any shortage in Extension of Time fees, to Deposit Account 14.1437. Please credit any excess fees to such account.

The present application is in condition for allowance, and applicants respectfully request favorable action. In order to facilitate the resolution of any questions, the Examiner is welcome to contact the undersigned by phone.

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# GRANT & HACKH'S CHEMICAL DICTIONARY

[American, International, European and British Usage]

*Containing the Words Generally Used in Chemistry,  
and Many of the Terms Used in the Related  
Sciences of Physics, Medicine, Engineering,  
Biology, Pharmacy, Astrophysics,  
Agriculture, Mineralogy, etc.*

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4th ed., published by McGraw-Hill in 1969. It was prepared by Dr.  
Julius Grant from a *Chemical Dictionary* compiled by Ingo W. D.  
Hackh. The current, or 5th, edition of this book was prepared by Dr.  
Roger L. Grant, whose father prepared the 4th edition.

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**aluminic acid**  $\text{H}_3\text{AlO}_3$ . A hypothetical tautomer of aluminum hydroxide,  $\text{Al}(\text{OH})_3 \rightleftharpoons \text{H}_3\text{AlO}_3$ .

**aluminiferous** A rock yielding or containing Al.

**aluminite**  $\text{Al}_2(\text{SO}_4)(\text{OH})_4 \cdot 7\text{H}_2\text{O}$ . Native, soft, white, monoclinic hydrous aluminum sulfate. Cf. *websterite*.

**aluminium** Aluminium\* (U.K. usage).

**aluminoferric** A mixture of aluminum sulfate and a ferrous salt, used to coagulate sewage.

**aluminum\*** Al = 26.98154. Aluminium. Metal and element of at. no. 13. One of the most abundant metals, isolated in an impure form by Oersted (1825), and in the pure form by Wöhler (1827) from sodium and aluminum trichloride. Silver-white, light, ductile metal,  $d_{20} 2.70$ , m. 660, b. 2460, soluble in acids or alkalis; readily oxidized and covered with a fine protective film of aluminum oxide. Used extensively for cooking utensils, a. foil, airplanes, boats, automobiles. A. forms many important alloys, e.g., *magnalium*, *electron*, *Duralumin*. A. has a valency of 3 and forms one series of compounds. Aluminates are derived from aluminum hydroxide (aluminum valency 3):

Aluminum ion .....  $\text{Al}^{3+}$   
Orthoaluminate .....  $\text{AlO}_3^-$   
Metaaluminate .....  $\text{AlO}_2^-$   
Alums .....  $\text{M}^+\text{Al}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$

**primary** ~ Virgin a. A. obtained direct from ore. **secondary**

~ A. from scrap metal. **triethyl** ~  $\text{Et}_3\text{Al}$  = 114.1. A. ethyl, a. triethide. Colorless liquid, b. 190; decomp. explosively in water to ethane and a. hydroxide. **trimethyl** ~  $\text{Me}_3\text{Al}$  = 72.1. A. methyl, a. trimethide. Colorless liquid, b. 130; decomp. in water to methane and a. hydroxide. **virgin** ~ Primary a.

**a. acetate**  $(\text{CH}_3\text{COO})_3\text{Al}$  = 204.1. Amorphous white powder, decomp. by heat, soluble in water. A 5% aqueous solution is used as a gargle, astringent, or antiseptic (USP). **a. acetate, basic**  $\text{Al}(\text{C}_2\text{H}_3\text{O}_2)_2\text{OH}$  = 162.1. A. subacetate. White crystals; used as a mordant and disinfectant, and for embalming. **a. ammonium sulfate\***  $\text{Al}_2(\text{NH}_4)_2(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$  = 906.6. Ammonium alum. Colorless, regular crystals, m. 94, soluble in water. Used for water purification and in baking powder, foam fire extinguishers, and electroplating; an astringent. **a. alkyls** Compounds of aluminum and alkyl radicals, e.g., trimethylaluminums. **a. alloys** Some m. (in °C) are:

	90% Al 10%	80% Al 20%	70% Al 30%	60% Al 40%	50% Al 50%
With					
Ag	625	615	600	590	580
Au	675	740	800	855	915
Cu	630	600	560	540	580
Fe	860	1015	1110	1145	1145
Sb	750	840	925	945	950
Sn	645	635	625	620	605

**a. arsenate\***  $\text{AlAsO}_4$  = 165.9. White powder, soluble in acids.

**a. benzoate\***  $\text{Al}(\text{C}_6\text{H}_5\text{O}_2)_3$  = 390.3. White crystals, soluble in water. **a. bifuoride**  $(\text{Al}_2\text{F}_6)_3(\text{HF})_4 \cdot 10\text{H}_2\text{O}$ . A. acid fluoride.

White crystals, soluble in water. **a. borate**  $2\text{Al}_2\text{O}_3 \cdot \text{B}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$  = 327.6. White granules, soluble in water; used in glass and porcelain. **a. bromate\***  $\text{Al}(\text{BrO}_3)_3 \cdot 9\text{H}_2\text{O}$  = 572.8. Colorless, hygroscopic crystals, m. 62, decomp. 100, soluble in water. **a. bromide\***  $\text{AlBr}_3 \cdot 6\text{H}_2\text{O}$  = 374.8. Colorless or yellow hygroscopic crystals, m. 93, soluble in water; used in organic synthesis. **anhydrous** ~  $\text{AlBr}_3$  = 266.7. Yellow

fuming scales; used in organic synthesis. **a. bronze** An alloy: Cu 90, Al 10%, m. 1050. **a. butoxide**  $\text{Al}(\text{OC}_4\text{H}_9)_3$  = 246.3. White powder, m. 102, decomp. in water. **a. carbide\***  $\text{Al}_4\text{C}_3$  = 144.0. Yellow hexagons, decomp. in water; used to generate methane. **a. carbonate\***  $\text{Al}_2(\text{CO}_3)_3$  = 234.0. White lumps, insoluble in water; a mild antiseptic. **a. caseinate** Yellow powder, insoluble in water. **a. cesium rubidium sulfate\***  $\text{Al}_2\text{CsRb}(\text{SO}_4)_4 \cdot 24\text{H}_2\text{O}$  = 1089. Cesium rubidium alum. Colorless crystals, soluble in water. **a. cesium sulfate\***  $\text{AlCs}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$  = 568.2. Cesium alum. Colorless crystals, m. 117, slightly soluble in water. **a. chloride\***  $\text{AlCl}_3 \cdot 6\text{H}_2\text{O}$  = 241.4. Colorless crystals, soluble in water. **anhydrous** ~  $\text{AlCl}_3$  = 133.3. Yellow crystals, m. 180, soluble in water. Used in Friedel-Crafts reaction; as an antiperspirant (USP); industrially as a catalytic agent and in refining petroleum; and as a reagent for naphthalene. **a. dichromate\***  $\text{Al}_2(\text{Cr}_2\text{O}_7)_3$  = 701.9. Red crystals, soluble in water. **a. ethoxide**  $\text{Al}(\text{OC}_2\text{H}_5)_3$  = 162.2. Triethoxyaluminum. White powder, m. 134, soluble in hot water; a reagent for water. **a. ethyl triethylaluminum\***  $\text{AlF}_3 \cdot 3\text{H}_2\text{O}$  = 143.0. Colorless crystals, slightly soluble in water, losing 2  $\text{H}_2\text{O}$  at 120. **anhydrous** ~  $\text{AlF}_3$  = 84.0. White powder, soluble in water; used in the glass industry. **a. fluorosilicate A. hexafluorosilicate\***  $\text{Al}_2(\text{SiF}_6)_3$  = 480.2. A. fluoro(silicate), a. silicofluoride. White powder, insoluble in water; used in the glass and enamel industries. **a. hydrate, a. hydroxide\***  $\text{Al}(\text{OH})_3$  = 78.0. White powder, insoluble in water; occurs native as gibbsite, hydrargyllite, and zirlite. With bases it forms salts; see *aluminic acid*. Used as an antacid and demulcent for indigestion and peptic ulcer (USP, BP); an astringent, dusting powder, mordant, filter aid, and neutralizing agent. **basic** ~ Includes  $\text{AlO}(\text{OH})$ , e.g., *boehmite*;  $\text{Al}_2\text{O}(\text{OH})_4$ , e.g., *bauxite*; also mixtures with the normal hydroxide. **a. hydroxide gel** An aqueous suspension of a. h. and alumina equivalent to 3.6-4.4%  $\text{Al}(\text{OH})_3$ , with preservative and flavoring; an antacid. **a. iodide\***  $\text{AlI}_3 \cdot 6\text{H}_2\text{O}$  = 515.8. White crystals, soluble in water. **anhydrous** ~  $\text{AlI}_3$  = 407.7. Brown crystals, m. 180, soluble in water; used in organic synthesis. **a. lactate\***  $\text{Al}(\text{C}_3\text{H}_5\text{O}_2)_3$  = 294.2. Yellow powder, soluble in water. **a. minerals A.** is the most abundant metal and is present in all rocks (except the limestones and sandstones), chiefly in silicates, e.g., feldspar, clays, micas, sillimanite.

**Bauxite** .....  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$   
**Bayerite** .....  $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$   
**Boehmite, diaspor.** .....  $\text{AlO} \cdot \text{OH}$   
**Corundum** .....  $\text{Al}_2\text{O}_3$   
**Cryolite** .....  $\text{AlF}_3 \cdot 3\text{NaF}$   
**Gibbsite** .....  $\text{Al}(\text{OH})_3$   
**Hydrargillite** .....  $\text{Al}_2\text{O}_3 \cdot 3\text{H}_2\text{O}$

andalusite, cyanite. The principal ores are corundum, bauxite, and cryolite. **a. nitrate\***  $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$  = 375.1. Colorless, rhombs, m. 73, decomp. 150, soluble in water. **anhydrous** ~  $\text{Al}(\text{NO}_3)_3$  = 213.0. White powder, soluble in water; used in the textile and leather industries. **a. nitride\***  $\text{AlN}$  = 41.0. Yellow crystals, m. 2150, decomp. by water. **a. oleate\***  $\text{Al}(\text{C}_{18}\text{H}_{33}\text{O}_2)_3$  = 871.4. White powder, soluble in alcohol.

Used in the manufacture of waterproofing materials, and as a paint drier. **a. oxalate\***  $\text{Al}_2(\text{COO})_6$  = 318.0. White powder, insoluble in water. **a. oxide**  $\text{Al}_2\text{O}_3$  = 101.0. Alumina, corundum. White powder, or colorless hexagons, d. 3.75, m. 2020, insoluble in water. Crystalline forms:  $\alpha$ - or corundum (the common form);  $\beta$ -, a mixed oxide,  $\text{M}_2\text{O} \cdot \text{Al}_2\text{O}_3$ , with alkali metals;  $\gamma$ -, by heating over 1000°C. An abrasive, refractory, and filtering material. Cf. *Alundum*, *borolon*. **a. palmitate\***